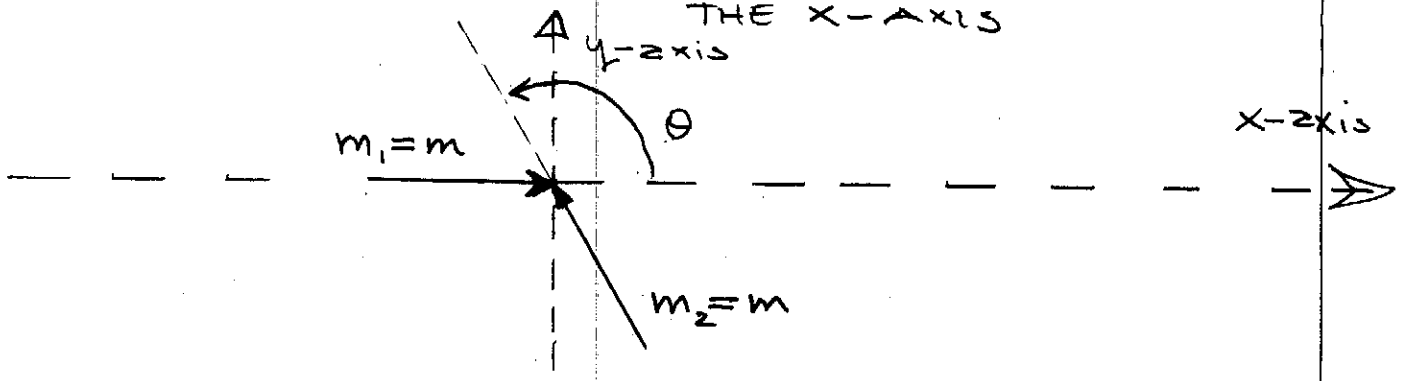
STAEDTLER® No. 937 811E Engineer's Computation Pad

•••75 After a completely inelastic collision, two objects of the same mass and same initial speed move away together at half their initial speed. Find the angle between the initial velocities of the objects.

LET ONE OF THE TWO MASSES INITIALLY MOVE ALONG THE X-AXIS



APPLY CONSERVATION OF MOMENTUM

$$\vec{P}_{\text{total initial}} = \vec{P}_{\text{total final}} \Rightarrow \vec{P}_{1i} + \vec{P}_{2i} = \vec{P}_f$$

NOTE COMMON SPEED & MASS

$$mv\hat{x} + [mv\cos\theta\,\hat{x} + mv\sin\theta\,\hat{y}] = \left[(m+m)\frac{v}{2}\cos\phi\,\hat{x} + (m+m)\frac{v}{2}\sin\phi\,\hat{y}\right]$$

NOTE: HALF SPEED & COMBINE

$$\Rightarrow mv + mv\cos\theta = 2m\frac{v}{2}\cos\phi \quad (x\text{-component})$$

$$\text{or } 1+\cos\theta = \cos\phi$$

$$\& \quad mv\sin\theta = (m+m)\frac{v}{2}\sin\phi \quad (y\text{-component})$$

$$\text{or } \sin\theta = \sin\phi$$

$$\Rightarrow \phi = \theta \quad \text{or} \quad \phi = 180 - \theta$$

$$1+\cos\theta = \cos\phi \Rightarrow \phi \neq \theta$$

$$\Rightarrow \phi = 180 - \theta \quad \& \quad 1+\cos\theta = \cos(180-\theta)$$

$$\Rightarrow 1+\cos\theta = -\cos\theta$$

$$\Rightarrow \cos\theta = -\frac{1}{2} \Rightarrow \theta = 120^\circ$$

$$\Rightarrow \phi = 180 - 120 = 60^\circ$$

(I drew the diagram to scale! after I deduced the answer.